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Quantifying the Magnitude and Severity of Absolute Poverty in the Developing World in the Mid-1980s

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and
Elaine Chan

Aggregate poverty would fall fairly rapidly if moderate growth in average consumption levels could be sustained *and* the poor could share at least proportionally in that growth. But it would take only small adverse shifts in the world distribution of income to wipe out the potential gains to the poor from economic growth.

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This paper — a product of the Agricultural Policies Division, Agriculture and Rural Development Department — was prepared as a background paper for the *1990 World Development Report* on poverty. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact the World Development Report office, room S13-060, extension 31393 (43 pages).

The authors estimate that about one in five persons in the developing world did not attain a consumption level of $23 per month in 1985 adjusted to constant $US purchasing power. About one in three persons did not attain a consumption level of $31 per month. They argue that a strong case can be made for treating the $23 figure as a reasonable lower bound for an absolute poverty line, while $31 is of interest as a common poverty line in low-income countries.

They find that the average consumption of the poor in the developing world was about 30 percent below either poverty line. This may be a very significant gap for a poor person. But, despite the large numbers of poor, the aggregate gap turns out to be a very small proportion of world consumption; for example, the aggregate poverty gap of the developing countries at the $31 poverty line is about 1.5 percent of the aggregate consumption of the non-socialist countries, falling to a mere 0.5 percent for the lower poverty line.

The authors find that aggregate poverty in the developing world will respond fairly elastically to economic growth, provided that the poor share at least proportionately in that growth. For example, a 1 percent annual growth rate at all income levels will reduce the proportion of the population that is poor by about 2 percent per year. If annual population growth rates stay at about 2 percent or lower, the total number of poor will decline.

However, the authors' results also suggest that even a seemingly modest worsening in distribution could upset this progress in poverty alleviation. For example, if the same 1 percent growth rate in average consumption was associated with only a 0.25 percent annual increase in the world Gini index of inequality, the reduction in the poverty gap attainable through growth would be virtually eliminated. Such a rate of increase in the world Gini index has been observed over recent decades, associated with the relatively low growth rates of a number of the poorest countries. In this case, the number of persons who do not attain even the most meager consumption levels would almost certainly increase.

On the other hand, a pattern of growth more favorable to the poor could rapidly accelerate global poverty reduction. The authors consider a rate of *decrease* in the world Gini index of 0.25 percent per year, roughly equivalent to a transfer of one-third of 1 percent of the world's mean income from the better-off half to the poorer half of the world's population. This would roughly double the rate of decrease in the aggregate poverty gap (measured against their higher poverty line) associated with a 1 percent annual growth rate in mean consumption of the developing countries. Instead of the decrease of 2.2 percent per year we could expect with distributionally neutral growth, we would see the poverty gap fall at an impressive annual rate of 4.5 percent.

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by
Martin Ravallion, Gaurav Datt,
Dominique van de Walle, and Elaine Chan

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* This was prepared as a Background Paper for the World Bank's *World Development Report 1990*.

1. Introduction

In counting the poor, and measuring the severity of absolute poverty, one faces a number of difficult questions. What poverty line should be used? Should one use the same poverty line across all countries? How should one adjust for differences across countries in the purchasing power of their currencies at official exchange rates? How should one interpolate from the available grouped data on the distribution of income? How should one extrapolate to countries for which distributional data are unavailable, or are highly imperfect? And, after answering these questions: What can we really learn from the static picture of poverty about the prospects for future poverty reduction?

This paper proposes a methodology for addressing these questions, and gives aggregate results for 86 developing countries in the mid-1980s. Our aim is to make a necessarily rough but methodologically consistent assessment of the magnitude and severity of absolute poverty, based on recent available data.

The following section suggests three possible interpretations of an "absolute poverty line" which might be considered appropriate for our purpose. This is followed in section 3 by an empirical examination of poverty lines for a number of countries, both developing and developed. This is used to identify two poverty lines for the subsequent analysis. Section 4 discusses issues which arise in measuring poverty from readily available data on income distributions, while section 5 outlines our approach to measuring poverty in countries for which such data are not available. Section 6 presents and discusses our estimates of the prevalence and severity of absolute poverty in the developing countries in the mid-1980s. An alternative, largely

independent estimate is presented in Section 7, based on a previous estimate of the world Lorenz curve. Section 8 discusses some of the implications of these results, particularly their bearing on the prospects for future poverty alleviation. The final section offers some conclusions.

2. Approaches to Defining an "Absolute Poverty Line"

Different societies have different perceptions of what constitutes "poverty", reflecting (in part) different overall levels of living. Our aim here is only to quantify the extent of absolute poverty in the developing world, interpreted as the inability to attain consumption levels which would be deemed adequate in only the poorest countries. This will leave out many persons who are clearly deprived relative to others around them.

There are a number of possible interpretations of an "absolute poverty line" for cross-country comparisons. Three possibilities can be suggested:

i) One can pick the cost of a bundle of goods which is reasonably well recognized as constituting an absolute minimum by international standards. The poverty line of India has been widely used for this purpose, and that alone makes its continued use compelling. But why India's poverty line, and not that of some other country? We should at least know how sensitive poverty counts may be to that choice. One might also argue that the poverty line for any country should reflect standards of that country. Two less arbitrary approaches can be suggested.

ii) In principle, one can think of the real poverty line as comprising an "absolute" component which is constant across all countries, and a "relative" component, which is specific to each country. In seeking to measure the extent of absolute poverty one might simply ask: What is the lowest real

poverty line observed in any country? This would seem to be a good indicator of the minimum acceptable poverty line in assessing absolute poverty. However, the answer may be quite sensitive to the particular countries surveyed and the inevitable measurement errors in assessing local poverty lines, and in comparing them across countries. It will also be influenced by inter-country differences in non-income factors; a country with good public services benefiting the poor, or a relatively low-cost climate, will naturally have a lower income poverty line. In the light of these considerations, a better approach is to try to assess a "typical" poverty line amongst the poorest countries. To implement this approach empirically, we can assume that the relative component for any country is largely determined by its mean income, though we allow the possibility of other factors (such as access to public services) which may also influence the poverty line. Thus we write the poverty line z as:

$$z = z(\mu, \epsilon) \qquad (1)$$

where μ is the mean income and ϵ denotes an unobserved random variable with zero mean, reflecting the non-income factors and measurement errors in z. A natural interpretation of the "absolute poverty line" is $z(\mu_{min}, 0)$, where μ_{min} is the lowest observed mean income. Equation (1) might also be used to define local poverty lines, including for those countries for which z has not been estimated, but μ is known.

iii) Building on the above argument, one can suggest a rather different interpretation of an "absolute poverty line" for cross-country comparisons. Suppose, in particular, that there exits a unique fixed point of equation (1), denoted z^*, such that

$$z^* = z(z^*, 0) \text{ and } z \geq \mu \text{ if and only if } z \leq z^* \qquad (2)$$

The meaning of z^* can be understood as follows. Consider countries with "typical" values of the non-income factors (ϵ=0), and with $\mu > z^*$. A resident with the average income in such a country is not poor by the standards of that country. Or, equivalently, if the average income could be equally distributed, nobody would be poor in that country. Consider instead a resident with the mean income of some country with $\mu < z^*$; that person is poor by the standards of that country - if the average income could be equally distributed everyone would be poor. For cross-country comparisons, z^* is thus one possible candidate for an absolute poverty line, interpreted as the level of income below which a "typical" citizen of a country would be deemed "poor" by the standards of that country.[1]

In the empirical work we will quantify each of these approaches to the definition of an absolute poverty line.

3. An International Comparison of Poverty Lines

Many countries now have reasonably well established (though rarely uncontentious) local poverty lines. From a wide range of sources within and outside the World Bank, we have compiled the local poverty lines for 33 countries, both developing and developed. These should not be considered as "official" poverty lines, either of the governments or the Bank. Many are the estimates of independent researchers. Nor has our survey been exhaustive; there are undoubtedly credible poverty lines we do not know about. When more than one poverty line was found (such as for urban and rural areas), the lowest was used. Appendix 1 gives the results and sources.

There are very likely to be measurement errors in our series on poverty lines, either because of the incompleteness of our survey, or errors in the primary data. However, to the best of our knowledge, those errors are random and, in particular, uncorrelated with average incomes. Thus we do not believe that these errors will bias our econometric estimates, and hence, our estimates of the absolute poverty line for cross-country comparisons.

In converting local poverty lines to a common currency, and indeed for all such comparisons in this study, we have used the estimates presented by Summers and Heston (1988) of the adjustments to official exchange rates needed to give purchasing power parity (PPP). Ideally one would like to construct new PPP rates for the prices most relevant to the absolute poor, in which the prices of food-staples would clearly carry a high weight.

The results of our survey of poverty lines are plotted against mean incomes in Figure 1. Mean income is measured by private consumption per capita, and both variables are for 1985 and are measured at PPP, using local CPI's when necessary. Figure 2 gives a "blow-up" of the part of Figure 1 for developing countries only. India's poverty line is $ .74 per person per month.

There is a clear tendency for the local poverty line to increase with mean income, though dispersion in poverty lines at most income levels is also evident, presumably reflecting non-income factors and/or measurement errors. The poverty line is below the mean in all cases. The Figure also gives our fitted values of the poverty lines. In modelling the variation in poverty lines we assume the following semi-log functional form for equation (1):

$$\log(z_i) = \beta_0 + \beta_1\mu_i + \beta_2(\mu_i)^2 + \epsilon_i \qquad i=1,..,33 \qquad (3)$$

The ordinary least squares estimates of these parameters from the data in Table 1 are as follows (with standard errors in parentheses):[2]

$$\log(z) = \underset{(.105)}{3.077} + \underset{(.00056)}{.00334\mu} - \underset{(.0000004)}{.0000011\mu^2} \qquad (4)$$

R^2=.90; SEE=.292; Mean d.v.= 4.04;
LM tests: NORM(2)=1.3; HETERO(1)=.21; RESET(1)=.22.

The actual and predicted values of z implied by the above regression are plotted in Figures 1 and 2. A test was also made for a structural break in the model between the developing and industrialized countries, but this failed to reject the null-hypothesis that the same model is valid for both.

The lowest mean consumption amongst the 86 countries studied in the Report is Somalia at $22 per person per month in 1985 PPP prices. At this point, equation (4) predicts a poverty line of $23, only slightly higher than that of India. Furthermore the "fixed point" of equation (4) is also $23 to the nearest dollar (the fixed point was estimated by a line search). Thus, all three definitions of the "absolute poverty line" discussed above give roughly the same figure. There is clearly a strong case for considering India's poverty line to be a reasonable lower bound to the absolute poverty line for the developing world.

However, it is also clear from Figure 1, that many low-income countries have more generous poverty lines. The $23 line is certainly on the low side of the range found amongst the poorest dozen or so countries in Figure 2. A more generous, and more representative, absolute poverty line for low-income countries is $31, which (to the nearest dollar) is shared by six of the countries in Table 1, namely Indonesia, Bangladesh, Nepal, Kenya, Tanzania, and Morocco, and two other countries are close to this figure (Philippines and

Pakistan). We shall use both these poverty lines, interpreting the lower line as defining "extreme absolute poverty".

A further question which the above results can throw some light on is the extent to which the poverty lines of poor countries might be expected to increase in the future, with increases in average living standards. We do not have time-series data on how poverty lines have evolved over time, but the cross-sectional evidence in Figure 1 is suggestive. Here we find that, although higher mean incomes are associated with higher poverty lines, the poverty line tends to be less responsive to increases in the mean at low income levels. At mean consumption per capita of $234 the elasticity of z with respect to μ implied by equation (4) is .66. However, at the income of India, the elasticity is very much lower, at .15. At the lowest income it falls to 0.07. In short: the cross-country comparison does suggest that real poverty lines will tend to increase with growth, but they will do so very slowly for the poorest countries. Notions of "absolute poverty" appear to be relevant to low income countries, while "relative poverty" is of more relevance to high income countries.

For our purposes, it is not unreasonable then to assume the same real absolute poverty line across all developing countries; two persons with the same real (PPP adjusted) income living in different countries will have the same measured poverty. This does not allow for differences between countries in relevant "non-income factors", such as access by the poor to public services.

4. Poverty Measures and their Estimation from Distributional Data

A wide range of existing poverty measures can be characterized by a function $P(z/\mu, L)$ which denotes the measured level of poverty in an economy in which the absolute poverty line is z, the mean "income" (or other suitable measure of living standards) is μ, and the distribution of income has the Lorenz curve L, which can be interpreted as a vector of parameters which fully characterize the structure of relative inequalities with the economy. The poverty line z may also be viewed as a function of μ (and possibly L), reflecting "relative poverty" considerations, though for the present discussion we will treat z as fixed. The function P is homogeneous of degree zero in z and μ; this is a very common property of poverty measures, and is unrestrictive. (Notice that the use of a poverty line which is a fixed proportion of the mean makes the poverty measure solely a function of the Lorenz curve; it might then be interpretable as a measure of inequality). We also assume that P is strictly increasing in z/μ; this is a sensible property for any poverty measure.

One quite straightforward approach to estimating $P(z/\mu, L)$ is to combine an estimate of the "world Lorenz curve" with our poverty lines, and an estimate of mean world income. There have been a number of estimates of the world Lorenz curve.[3] Early attempts ignored inequality within countries, but the more recent studies have used distributional data for a sub-set of countries, and assumed homogeneity within incomes groups (usually deciles) in aggregation. The most recently available world Lorenz curve is for 1986 (Berry et al., 1989), though this is based on 1970 Lorenz curves for individual countries (a sample of about 20 countries). The world Lorenz curve

is then up-dated solely according to country specific growth rates in national income.

Nonetheless, this may still give a satisfactory estimate, if relative inequalities within countries have changed little over the period 1970-1986, or if the world Lorenz curve is insensitive to whatever changes have occurred. Berry et al., (1983, 1989) defend their estimates along these lines, and their earlier paper presents evidence indicating that their measures of world inequality would respond little (in elasticity terms) to changes in inequality within most countries. However, their results do indicate quite high elasticities (over 1 for the world Theil index with respect to the national index) for some of the larger countries, including China and India. Some up-dating of at least these key distributions is clearly called for, and is feasible; for example, we now have quite recent estimates of distributions for both China and India. It may also be noted that we are interested in measuring poverty here, not inequality per se, and aggregate poverty measures can be quite sensitive to certain shifts in the Lorenz curve, a point which we will return to later.

In the light of these considerations, this study will try to exploit the fact that much more recent, and probably more reliable, distributional data have become available since 1970; indeed, all of the distributions we shall use are for the 1980s. We shall thus start fresh. It will be of interest to compare the results with those obtained using the Berry et al. world Lorenz curve for 1986.

When our data for a given country include a usable distribution of household consumption or income, we proceed by first estimating the parameters of the Lorenz curve L, and then we combine this with an estimate of z/μ to

calculate P according to the explicit functional form appropriate to the specific poverty measure being considered (as discussed later).

This still leaves many countries for which adequate distributional data are unavailable. When we do not have an empirical distribution, we use an econometric extrapolation based on available correlates of poverty over the sub-set of countries with such data. This is probably a better practice than assuming that the available distributions are representative. Section 5 discusses the extrapolation method in detail.

Given an explicit functional form for P, the contribution of changes in average incomes (for given distributions) to poverty alleviation can be estimated. A useful "benchmark" case is that of distributionally neutral growth, defined as an increase in μ holding L constant. However, this should only be viewed as a benchmark; there can be no presumption that growth is distributionally neutral, and from past experiences the departures from neutrality could go either way.

The specific functional form of $P(z/\mu,L)$ depends on i) the functional form of the poverty measure and ii) the parameterization of the Lorenz curve. The rest of this section discusses the assumptions we have made about functional forms in detail.

Two specific poverty measures are considered: the headcount index (H) given by the proportion of the population with incomes below the poverty line, and the income gap ratio (G) given by the average income distance of the poor from the poverty line, expressed as a proportion of the poverty line. Thus, letting F denote the cumulative distribution of income, we have that $H = F(z)$ and $G = 1 - \mu^P/z$, where μ^P is the mean income of the poor. There are advantages in following Foster et al. (1984) in normalizing the index by

population size, rather than the number of poor. We then obtain the poverty gap ratio defined as PG=G.H.[4] This is a more computationally convenient normalization, as it implies that the aggregate measure across any number of sub-groups is (like H) simply the population weighted mean of the sub-group values of PG. That is not the only advantage. The additivity property also guarantees that measured poverty is sub-group monotonic, meaning that if poverty increases (decreases) within a sub-group then (ceteris paribus) aggregate poverty will also increase (decrease) (Foster et al., 1984).

There are a number of options in specifying a parametric form for the Lorenz curve. We considered three possibilities: the original Kakwani and Podder (1973) specification, the later Kakwani specification (Kakwani, 1989), and the class of elliptical Lorenz curves (Villasenor and Arnold, 1989). All three can be readily estimated econometrically.

To test their performance, we compared their fit on the 1984 empirical Lorenz curve for Indonesia (Ravallion and Huppi, 1989).[5] Table 1 gives the results obtained. Both the Kakwani and elliptical models clearly yield a better fit than the Kakwani-Podder model. The ranking of the Kakwani and elliptical models is less clear; the standard deviation of the error is slightly lower for the elliptical model, though this is mainly due to its better fit at the upper end of the distribution. The Kakwani model clearly fits better at the lower end, and this is where accuracy in poverty measurement will be most affected.[6] The computer program we have written for the WDR calculations allows both specifications, though the Kakwani specification has generally been preferred.

The calculation of the two poverty measures, H and PG, proceeds as follows. Let L(p) denote the Lorenz curve, giving the estimated proportion of

income held by the poorest p% of the population. H can be obtained using the well-known fact that $x=\mu L'(p)$ is the inverse function of the distribution function $p=F(x)$, and so $L'(H) = z/\mu$. This has to be solved numerically for both Lorenz curve specifications, though the problem is straightforward (Newton's method was used here). The poverty gap is then obtained readily using the fact that $\mu P = \mu L(H)/H$.

These methods will not always work well. For example, if there are very few class intervals in the available data for the poor, then any estimate of poverty will be subject to error. Also, certain groupings of the data can yield distorted estimates of the Lorenz curve; for example, econometric estimates of the parameters may not satisfy the theoretical conditions required of a Lorenz curve.[7] The program written to perform these calculations checks those conditions and uses quadratic or linear interpolation as options.[8]

One obvious determinant of the accuracy of the resulting estimates is the accuracy of the input data. This is not just a matter of measurement error in the original surveys (which can be a serious problem in its own right) but it also involves the way the survey results have been presented, and, in particular, the number of income class intervals presented for the lower end of the distribution. Our computer program includes obvious checks such as whether the estimated headcount index lies within the bounds of the relevant interval in the grouped data. (If it does not then the quadratic interpolation method is used). But ultimately one has little option but to rely on the most detailed grouped data available.

To help assess the accuracy of these methods, Table 2 presents an experiment we conducted, in which we estimated poverty in Indonesia for 1984 using z=$31, and alternatively calculated using:

i) the primary data tapes of the SUSENAS surveys of household consumption (from Ravallion and Huppi, 1989),

ii) parameterized Lorenz curves (using the Kakwani specification) calibrated to a detailed description of the frequency distribution based on 50 class intervals formed from the unit record data, of which 18 intervals are below the poverty line,

iii) Lorenz curves calibrated to far more "coarse" frequency distributions using 15, 10, and 5 class intervals, of which 8, 4, and 2 respectively are below the poverty line. These are typical of the detail usually available from published sources. With the more aggregated data it is also very common for the poverty line to fall well within a class interval. We also present results for this case, where we have constructed grouped distributions in which the poverty line is in the middle of a class interval.

The results confirm a loss of accuracy in using grouped data, though it is not large; the headcount index, for example, is estimated within three-quarters of a percentage point using the grouped data. Furthermore, the loss of accuracy is remarkably unaffected by contraction in the number of class intervals in the grouped data. We do not know how specific this result is to these data (as we rarely have access to the unit record data). However, it does suggest that there need not be much loss of accuracy in using even highly aggregated data for measuring poverty.

Problems of comparison across countries are another source of error in the aggregate estimates. Available distributions generally pertain to either

household income or consumption at one point in time, and are either household aggregates or are normalized by the number of persons in the household. Our first preference was to use a distribution of household consumption per person. When not available, income distributions were used instead, adjusted pro rata according to an average propensity to consume estimated from national accounts. If the distribution was in household form, we adjusted it according to either income specific or average household sizes, for which purpose one has no choice but to assume that the ranking of households is the same.

All currency conversions use constant purchasing power exchange rates, based on Summers and Heston (1988). For two countries, Burma and China, PPP rates are not given in this source. We estimated these from an extrapolation model of the PPP rates across the other 84 countries. The variables used for extrapolation were the official exchange rate, the mean income at official exchange rates, and various social indicators. For both countries, the constant PPP exchange rate is estimated to be about one quarter of the official rate. Appendix 2 gives details on the model used.[9] The estimated PPP for China as a proportion of the official exchange rate is 23%, which is very close to the estimate for 1975 reported by Kravis (1981) of 24% (using the geometric mean of PPP estimates based on US and China expenditure weights).

However, imprecision in the estimated PPP for China is likely to be an important source of imprecision in the final poverty estimates, given the country's population share and (as we will see later) the high elasticity of the country's distribution function in the region of the poverty lines. We shall return to this point.

Appendix 3 gives summary information on the data and the estimation methods used for the 22 countries for which adequate distributional data were available. Data are known to exist for other countries, but were either not available, or deemed inadequate for our purposes. The average population size of this set of countries is much higher than the average for the 86 countries, so that these 22 countries represent 76% of the total population covered. Poverty counts for the remaining countries have been based on extrapolations. The next section outlines the methodology.

5. Extrapolations When Distributional Data are Unavailable

The extrapolations have been based on a set of variables which are available in a fairly complete series across the 86 countries. These variables include mean consumptions for 1985 as estimated from national accounts and converted to constant $US using the 1985 PPP deflators, and a set of social indicators, including life expectancy, infant and child mortality, primary and secondary school enrollment rates, proportion of the population in the labor force, female labor force participation, and the share of the population living in urban areas. Denoting these variables by the vector $\mathbf{x}$, the extrapolations are based on the following econometric model estimated for the countries for which the distributional data are available:

$$\log(H_i/(1-H_i)) = \mathbf{x}_i\boldsymbol{\pi} + \epsilon_i \qquad (5)$$

where $\boldsymbol{\pi}$ is a vector of parameters to be estimated and ϵ is a suitable random error term. A similar model was estimated for PG. The logit transformation of both poverty measures is used to guarantee that the predicted values of the measure are within the theoretical bounds (0,1) and that ϵ is theoretically

un-bounded. Initial runs of the model were based on a wide set of social indicators and their multiplicative interactions, and only variables with standard errors less than the estimated coefficients were deleted, aiming to minimize the regression's standard error of estimate. The final model for the headcount index across 22 countries using the upper poverty line ($31/month) is as follows:

$$\log(H/(1-H)) = \underset{(.28)\ (.12)}{(-1.19 - .18PPP/X)\log\mu} + \underset{(.88)}{3.26\log IMR} - \underset{(.0004)}{.0014LE.IMR} - \underset{(.009)}{.014U} - \underset{(.0003)}{.0009WLF^2}$$

$R^2 = .80$; SEE = .57; Mean d.v.= -1.37;
LM tests: NORM(2)=.31; HETERO(1)=.13; RESET(1)=1.5. (6)

where μ denotes private consumption per capita evaluated at PPP, X is the official exchange rates, IMR is the infant mortality rate, LE is life expectancy at birth, WLF is the proportion of the labor force who are women, and U is the proportion of the population living in urban areas. Similar results were obtained for the lower poverty line, and the poverty gap index, for both poverty lines.

Figure 3 gives the "actual" and "fitted" values of the headcount index of poverty for the upper poverty line; the correlation coefficient is .93. The figure also highlights the points for the two largest countries, China and India. The estimate from distributional data is below the regression line for China (though the difference is small), and above it for India (a somewhat larger discrepancy). The reasonably close fit for China is reassuring given that the country's PPP rate had to be estimated. Overestimation of the PPP would tend to push the "actual" headcount index above the regression line,

rather than below it, noting that the fitted value is less responsive to changes in the PPP than is the actual value; as we shall discuss below the elasticity of China's headcount index with respect to μ is high. (The elasticity of the right hand side of equation 6 w.r.t. the PPP is 1.1. The elasticity of the left hand side is 2.7, using the arc elasticity of H between the two poverty lines.)

It should also be noted that there are many potentially important country specific effects which will not be captured by the extrapolation model. This is of no concern for the sample of 22 countries (as we shall, of course, use the actual values for those countries). But it is more worrying for the other countries. For example, Egypt's extensive food subsidy program has undoubtedly reduced poverty below the value that equation 6 would predict. And there are no doubt other countries for which the opposite is true.

On the whole, however, the within sample predictive performance of the extrapolation models seems adequate for the purpose of estimating aggregate poverty in the countries for which distributional data are unavailable. However, the individual country extrapolations should be treated as very approximate. We shall calculate standard errors for the aggregate measures.

6. The Estimates of Aggregate Poverty in the Developing Countries

Our estimates of both poverty measures for both poverty lines for the 86 developing countries are given in Table 3. About one in three persons in the developing countries fail to attain our upper poverty line, while one in five do not reach our lower line, defining extreme poverty. The combined population size of the countries covered is 3,442 million, so the estimated total number of poor is 1,137 million, of which 645 million are deemed to live

in extreme poverty. We shall consider some implications of these results in the following section.

It should go without saying that these are rough estimates only. There are a number of sources of imprecision in the estimation methods. Most are familiar, such as measurement errors in the underlying distributions, or errors in the estimated PPP rates. One source of error, on which we can readily comment further, is our use of extrapolations for those countries for which adequate distributional data were unavailable. We have calculated the 95% confidence interval around the point estimate for each of the countries for which extrapolations have been used. The poverty measures for the 22 countries for which we have used distributional data are assumed to be measured without error. The implied confidence intervals around the aggregate point estimates are given in parentheses in Table 3.

The aggregate headcount index is found in the range 28-39% with 95% confidence using the upper poverty line and 15-25% using the lower line. The corresponding confidence intervals for our estimates of the numbers of poor are 960-1348 millions and 513-876 millions.

Another source of error is in the estimation of a PPP rate for China's currency. This is worrying for two reasons. Firstly, although poverty is below average in China, given the country's size it still accounts for a large share of aggregate poverty. Secondly, the income distribution function for China is unusually steep in the region of the poverty lines; our estimates of the headcount index at the upper and lower poverty lines imply an elasticity of 3.7 (as compared to an elasticity of about two for the developing countries as a whole). This undoubtedly reflects distributional policy in China. By implication, aggregate poverty measures will be quite sensitive to errors in

measuring the PPP rate of exchange for China; the elasticity of the aggregate headcount index at the lower poverty line with respect to China's PPP rate will be about .54. Suppose, for example, our PPP rate has been over-estimated by 10%. This would imply about a 5% overestimation in the aggregate headcount index, which would fall by one percentage point, or about 35 million people.

Table 3 also gives the regional breakdown of the poverty measures, both point estimates and 95% confidence intervals. The confidence intervals for the upper poverty line are plotted in Figure 4. The estimates are clearly far more accurate for some regions than others. In particular, while we have used distributional data for three-quarters of the aggregate population, such data were only available for 11% of the population of the Middle East and North Africa region and a mere 6% of the population of Sub-Saharan Africa. At the other extreme, the Asia coverage is excellent, being 95% of the population of South Asia, and 97% of the population of East Asia. (The Latin America coverage is 55%, while for Eastern Europe it is 85%). These regional variations in survey coverage are clearly reflected in the 95% confidence intervals around the point estimates given in Table 4. While we can be reasonably confident about our estimates for South Asia, for example, very wide margins for error must be allowed around those for Sub-Saharan Africa and the Middle-East/North-Africa.

Subject to this (important) caveat, we find that for the upper poverty lines the highest headcount index is for South Asia, closely followed by Sub-Saharan Africa. However, this order reverses for the lower poverty line. The same observation holds for the poverty gap index. Loosely speaking, the incidence and severity of "moderate" absolute poverty can be said to be

highest in South Asia, while that of "extreme" poverty is highest in Sub-Saharan Africa.

It should be recalled that these poverty assessments will not necessarily accord with local perceptions of poverty, since we have used fixed absolute poverty lines across all countries. For example, our counts for Latin America will seem low to observers familiar with the results obtained using the (typically) higher poverty lines of that region. Conversely, our counts for some regions will seem high. For example, a commonly used poverty line for China translates into about $25 per person per month at our estimated PPP rate. This is well below our upper poverty line, and (as we have already discussed) China's distribution is very steep in this region, so our figure for the upper poverty line is much higher than local assessments. Our lower poverty line is more consistent with perceptions of poverty in China.

7. An Alternative Estimate Based on the Berry et al., World Lorenz Curve.

As an aside, it is of interest to compare our results with an alternative method of estimating aggregate poverty using the Berry et al., (1989) estimate of the world Lorenz curve of consumption for 1986 (based on 1970 distributions, and national growth rates over the intervening period). From the results of Summers and Heston (1988), we estimate mean consumption per capita of the non-socialist countries to be $230 per person per month in 1985 at PPP.[10] Table 5 gives our estimates of both poverty measures for both poverty lines.[11] We also give an estimate which includes our figure for China. The total population covered is then 4,278 million, and the main difference in coverage over the earlier results is that this now includes the industrialized countries. It is reasonable to assume that the number of

persons in the industrialized countries who do not attain these very low poverty lines (by the standards of those countries) would be negligible. Thus the estimated numbers of poor should be comparable with those we obtained earlier.

We find that there are 1031 and 691 million for the upper and lower poverty lines respectively, by this alternative estimation method, as compared to 1137 and 645 million by our earlier method. The two methods are in reasonably close accord.

8. Some Implications

There is only so much one can learn from a single "snapshot" of poverty. However, a number of observations of possible interest can be made about our main results in Table 3.

We are clearly looking at a fairly steep segment of the income distribution function for the developing countries; in going from the lower to the higher poverty line in Table 3 the headcount index increases from 19% to 33%, representing an elasticity of 2.2.[12] This implies that, in the region of these poverty lines, the headcount index of poverty will decrease with an elasticity of 2.2 under distributionally neutral growth (recalling that the poverty measure is homogeneous of degree zero in z and μ).

For example, at a growth rate in real mean income of 1% per year, and without any change in relative inequalities, the headcount index will decline at about 2% per year. If the rate of population growth does not exceed this amount, then the number of poor will also decline. In fact, the average rate of population growth in the developing countries is about 2% per year, so the total number of poor will be in decline as long as the developing countries

can attain a distributionally neutral growth rate in mean income of at least 1% per year.

The aggregate poverty gap is 10% and 5% of the poverty line for the upper and lower poverty lines respectively. This can also be expressed as a proportion of mean income. (The aggregate poverty gap as a proportion of aggregate income is given by PG times z/μ.) The mean income of the sample of 86 countries is $102 per person per month in 1985, at PPP. Thus the aggregate poverty gap represents 3.1% and 1.1% of aggregate income for the upper and lower poverty lines respectively. Also recall that this calculation uses the aggregate income of the developing countries; the proportion of aggregate income of the non-socialist countries is a good deal lower at 1.5% and .5% respectively.

Provided that income gains could be perfectly targeted to the poor, and without reducing mean income, these calculations suggest that only modest gains to the poor would be needed to eliminate poverty. For example, with less than one half of one percent of world income perfectly targeted without distortion, one could guarantee that everyone in the world could reach at least India's poverty line.

However, neither of these provisos should be taken lightly. For example, the information needed for perfect non-distortionary targeting to the poor is not readily available, and may, indeed, be very costly to obtain. The potential impact on poverty of informationally feasible targeting may be far more modest (see, for example, the simulations reported in Ravallion, 1990, and Datt and Ravallion, 1990). To illustrate how much informational constraints could bite into the impact on poverty suppose instead that absolutely no targeting was possible i.e., each person receives the same

income gain, irrespective of their initial position. Assuming that the lowest income is zero, the transfer needed to eliminate poverty would be the proportion z/μ of total income. Clearly this is very much higher than the amount needed to eliminate poverty with perfect targeting; the necessary proportion of the aggregate income of the non-socialist countries would be 13% and 10% for the upper and lower poverty lines respectively. Thus, depending on the information available for targeting, between .5 and 10% of aggregate income would be needed to guarantee that nobody in the developing world falls below India's poverty line. Of course, in practice we will at least know countries of residence and this will undoubtedly be a useful indicator for targeting. The 10% estimate could be well above the actual cost of eliminating poverty with readily available information.

Our results can also throw light on the prospects for alleviating poverty through economic growth. The point elasticity of the poverty gap index with respect to distributionally neutral growth is given by 1 - H/PG (also equal to $-\mu^P/(z-\mu^P)$), and can be readily calculated from the data in Table 3. The implied absolute elasticities are 2.2 and 2.7 for the upper and lower poverty lines respectively. At a growth rate in the mean of 1% per year, and without any change in relative inequalities, the mean poverty gap will decrease at a rate of 2-3% per year, over the range of poverty lines considered.

However, deviations from distributionally neutral growth can matter to the future prospects for reducing absolute poverty. This will depend on the way in which Lorenz curves shift. Following Kakwani (1989) let us assume that the shift in the Lorenz curve L(p) at each value of p is directly proportional to p - L(p) i.e., the Lorenz curve shifts by a constant proportion of the difference between each income group's actual share of total income, and the

share it would have if there were perfect equality. We cannot know if this is plausible, though it has been found to give an excellent approximation to recent shifts in Indonesia's Lorenz curve (Ravallion and Huppi, 1989). It also yields quite a close approximation to the shifts in world Lorenz curves from 1960 to 1986, and from 1970 to 1986, reported by Berry et al., (1989).[13]

Under this assumption, the elasticity of the poverty gap index with respect to the Gini index is given by $1+(H/PG)[(\mu/z)-1]$ (Kakwani, 1989). Notice that this takes a value of 1 if the poverty line equals the mean. Thus, for example, the elasticity is found to be around one for Bangladesh (Ravallion, 1990). However, for the developing countries as a whole (and, indeed, the world distribution), the poverty line is low relative to the mean. When combined with the "skew" in the aggregate Lorenz curve associated with the disparities in means across countries, this has the effect that the elasticity of poverty with respect to the Gini index can be very much higher than 1.

This is exactly what we find from our results in Table 3. The elasticity of the poverty gap is 8.4 for the higher poverty line, and 13.6 for the lower one. Thus even small deviations from distributionally neutral growth could have a significant impact on progress in reducing world poverty. Consider again the effect of a 1% growth rate in mean income, representing a 16% increase in the mean over the 15 years from 1985 till the end of this century. The entire effect of this gain in average income on the poverty gap for our higher poverty line would be wiped out if it was associated with a 4.3% increase in the Gini index over this 15 year period. For the lower poverty line it would take a 3.1% increase in the Gini index.

A 3-4% increase in the Gini index between 1985 and 2000 is not inconceivable; for example, Berry et al., (1989) report that the world Gini index increased by 5% between 1960 and 1986, and by 3% between 1970 and 1986. Taking their estimate of the world Gini index for consumption in 1986 of 0.67, a 4% increase would bring this up to 0.70 by 2000. This would be equivalent to a lump-sum transfer of 6% of the world mean, from each person below the median to each person above it, over 15 years (or about 0.4% of the mean per year).[14]

Another way to gauge the implications of our results for future poverty reduction is to ask: How many years at a given growth rate would pass before a person with the average income of the poor crossed the poverty line; see Kanbur (1987), who calls this the "cross-over time". The income gain needed to bring the average income of the poor in 1985 up to the poverty line is readily calculated from the H and PG poverty measures, as follows: Mean income of the poor is $z(1-PG/H)$. The cross-over time if incomes of the poor grow at the rate of r% per year is given by $\log[H/(H-PG)]/\log(1+r/100)$. Figure 5 gives the values of this expression implied by the results of Table 3 for both poverty lines and various growth rates. For example, at a 1% growth rate in mean income of the poor, it will take about 32 years to bring the average poor person (i.e., a person with the average income of the poor) up to an income per capita of $23 per month. It would take an additional 5 years to get the average poor person up to $31 per month. At a growth rate of 2% it will take half this time.

One can also calculate the rate of growth in incomes of the poor needed to bring the average poor person up to the poverty line in a specified time period. For example, the growth rate in incomes of the poor needed to do this

by the year 2000 from a 1985 base date is given by (exp{log[H/(H-PG)]/15} - 1)100. The necessary growth rate is 2.5% per year for the higher poverty line, and 2.1% for the lower one.

Thus, the growth rates needed to bring a typical poor person up to the poverty line are not particularly high. Many developing countries have been able to attain these growth rates in national income over recent times (much of Sub-Saharan Africa being an important exception). Provided that the poor share at least proportionally in that growth, the prospects for the alleviation of absolute poverty look good.

But again it should be emphasized that this proviso is very important. For example, while a distributionally neutral growth rate of 2% per year would bring the average income of the poor in 1985 up to $31 per month in roughly 2 decades, if the same national growth rate was only associated with a 1% annual gain in average income of the poor, then it would take nearly 4 decades to do so. Conversely, if the 2% growth rate in the national mean was associated with a 3% growth rate in the income of a typical poor person in 1985, then that person should be able to cross even our higher absolute poverty line before the end of the century.

9. Conclusions

Our aim here has been to quantify the magnitude of absolute poverty, when assessed by the standards of the poorest countries. Thus we have used the same poverty line (adjusted for differences in purchasing power) for all developing countries, and we have chosen that line to accord with observed poverty lines in the poorest countries. Not unsurprisingly, much higher poverty lines are found in middle and high income countries, and with growth

in mean incomes it is plausible that poverty lines of the poorest countries will need to be raised, to reflect rising living standards generally. However, from our cross-sectional comparisons of poverty lines at various income levels, it appears that the relationship between a country's poverty line and mean income tends to be quite flat at low income levels. It appears that "relative poverty" considerations only emerge strongly at fairly high incomes. Thus it can be argued that absolute poverty lines for the poorest countries will change very little as growth initially proceeds, and it is not unreasonable to use a common absolute poverty line.

A strong case can be made for treating a consumption level of $23 per person per month in 1985 as a reasonable lower bound for the poverty line. This has been widely used in poverty assessments for India, and we have suggested other arguments which make that figure compelling. However, for comparative purposes it is also worth considering a rather less meager criterion. We find that a consumption level of $31 per month is actually a far more common poverty line amongst the dozen or so low income countries for which poverty lines have been calculated. The range $23-31 embraces quite well the poverty lines used by low income countries.

In measuring the magnitude and severity of absolute poverty in the developing countries, we have used recently available distributions of consumption or (occasionally) income for a sub-set of countries, accounting for about three-quarters of the total population covered by the estimates. We have then used regression models calibrated to data on average incomes and various social indicators for that subset to extrapolate to the remaining quarter of the population. Allowing only for imprecision in the extrapolations, our method yields acceptably low variances in estimates of

aggregate poverty. We have also considered an alternative methodology, based on recent estimates of a world Lorenz curve. Allowing for the differences in methodology and coverage between these two approaches, it is encouraging that they yield quite similar results on the magnitude of absolute poverty.

However, it should go without saying that these estimates are no better than the quality of the underlying data allows. We have made a number of tests of the reliability of our estimates. Two points stand out:

i) China's high population share, and the fact that China's income distribution is particularly steep at the lower end, make our estimates of aggregate poverty particularly sensitive to errors in estimating the PPP rate for China.

ii) The very limited coverage of the available distributional data for Africa has necessitated the use of extrapolations from other data for most of that region, giving greater imprecision than for other regions. This should be of concern, particularly given the current high incidence of poverty in the region, and the low expected growth rates.

In assessing the overall magnitude of poverty in the developing world, we estimate that about 1,137 million people in the developing world did not attain a consumption level of $31 per month in 1985. Of these, 645 million did not attain our lower, and extremely frugal, poverty line. The severity of poverty amongst the poor can be gauged by their average poverty gap. We find that the average consumption of the poor in the developing world was about 27-31% below the poverty line (for lower and higher poverty lines respectively). This may be a very significant gap for a poor person. But, despite the large numbers of poor, the aggregate gap turns out to be a very small proportion of world consumption; for example, the aggregate poverty gap of the developing

countries at our slightly more generous poverty line is about 1.5% of the aggregate consumption of the non-socialist countries, falling to a mere 0.5% at our lower poverty line. This suggests that, with perfect targeting, it would take only a modest re-distribution of world income to bring everyone up to these minimal consumption levels. However, the information available to policy makers is generally a lot less than one would need for perfect targeting. So this calculation may substantially under-state the magnitude of the transfers needed to eliminate absolute poverty in practice.

Our results imply that aggregate poverty in the developing world will respond fairly elastically to distributionally neutral growth; for example, a 1% annual growth rate at all income levels will reduce the proportion of the population who are poor by about 2-3% per year. If annual population growth rates stay at about 2% or lower, then the total number of poor will decline.

However, our results also suggest that even a seemingly modest worsening in distribution could upset this progress in poverty alleviation. For example, if the same 1% growth rate in the mean was associated with only a 0.25% annual increase in the world Gini index of inequality, then the reduction in the poverty gap attainable through growth would be virtually eliminated (assuming that the Lorenz curve shifts out roughly "proportionately" at all points). Such a rate of increase in the world Gini index has been observed over recent decades, associated with the relatively low growth rates of a number of the poorest countries. In this case, the numbers of persons who do not attain even the most meager consumption levels would almost certainly increase.

By the same token, a pattern of growth more favorable to the poor could rapidly accelerate global poverty alleviation. Consider, instead, a rate of

decrease in the world Gini index of .25% per year, roughly equivalent to a transfer of one third of one percent of the world's mean income from the better off half to the poorer half of the world's population. This would roughly double the rate of decrease in the aggregate poverty gap (measured against our more generous poverty line) associated with a 1% annual growth rate in mean consumption of the developing countries; instead of the decrease of 2.2% per year we could expect with distributionally neutral growth, we would see the poverty gap fall at an impressive annual rate of 4.5%.

Table 1: Alternative Estimates of the Lorenz Curve for Indonesia, 1984

Proportion of the population	Actual Lorenz curve	Lorenz curve specification		
		Kakwani-Podder	Kakwani	Elliptical
10	3.40	3.54	3.42	3.52
20	8.14	7.87	8.12	8.15
30	13.82	13.20	13.77	13.77
40	20.42	19.75	20.35	20.36
50	27.97	27.72	27.93	27.95
60	36.62	37.40	36.64	36.64
70	46.57	49.08	46.70	46.65
80	58.40	63.12	58.55	58.43
90	73.31	79.93	73.21	73.18

Table 2: Alternative Estimates of Poverty in Indonesia, 1984

Poverty measure	Calculated directly from unit record data (sample size=50,000)	Number of intervals used in estimation from grouped data: 50 (18 "poor")	15 (8 "poor")	10 (4 "poor")	5 (2 "poor")
H: Headcount index (%)	33.02	33.74	33.64	33.76 33.88*	33.50 33.63*
PG: Poverty gap index (%)	8.52	9.10	9.04	9.09 9.17*	9.07 9.10*
Foster, Greer and Thorbecke measure (α=2,%)	3.17	3.40	3.37	3.39 3.44*	3.41 3.41*

* Poverty line in the middle of the class interval.

Table 3: Estimates of Poverty Measures for the Developing Countries 1985

Region	Poverty line ($/ps/mn)	Headcount index: Point estimate	Headcount index: 95% confidence interval	Poverty gap index: Point estimate	Poverty gap index: 95% confidence interval
Aggregate	31	33.0	(27.9, 39.2)	10.2	(8.4, 14.3)
estimates	23	18.8	(14.9, 25.5)	5.1	(4.0, 8.9)
By region:					
South Asia	31	50.9	(49.8, 52.6)	15.9	(15.5, 16.9)
	23	29.4	(28.7, 31.1)	7.2	(7.0, 8.1)
of which India:	31	55.0		17.6	
	23	32.7		8.2	
East Asia	31	21.2	(21.1, 21.5)	6.0	(5.9, 6.0)
	23	9.7	(9.6, 9.9)	2.8	(2.8, 2.9)
of which China:	31	21.1		5.9	
	23	9.2		2.9	
Sub-Saharan	31	46.9	(18.6, 75.7)	15.0	(5.4, 36.5)
Africa	23	30.5	(8.9, 65.0)	7.7	(2.1, 27.5)
Middle-East and	31	31.0	(13.3, 50.9)	9.6	(3.3, 24.0)
North Africa	23	20.6	(6.4, 42.4)	5.5	(1.5, 19.3)
Eastern	31	7.8	(7.3, 9.7)	2.6	(2.4, 3.3)
Europe	23	4.3	(4.0, 5.7)	1.4	(1.3, 2.0)
Latin	31	19.1	(14.0, 28.9)	6.9	(5.2, 11.5)
America	23	12.5	(9.0, 21.0)	5.1	(4.0, 9.6)

Table 4: Aggregate Poverty Measures in 1985 Based on a World Lorenz Curve

Poverty measure	Poverty line ($/ps/mn)	Non-socialist countries (Elliptical model of Berry et al., 1989 Lorenz curve) (s=.76)	China (s=.24)	Aggregate poverty (Non-socialist + China)
H: Headcount index (%)	31	25.1	21.1	24.1
	23	18.4	9.2	16.2
PG: Poverty gap index (%)	31	10.8	5.9	9.6
	23	6.9	2.9	5.9

Note: n=no.countries, s=population share, total population=4,278 million.

Appendix 1: Poverty Lines for 33 Countries

Country	Poverty line (per capita/per month/$ 1985 PPP)	Mean consumption (per capita/per month/$ 1985 PPP)	Source/comments
Australia	263.75	552.67	Johnson, D. 1987. "The calculation of poverty lines in Australia." Australian Economic Review 4th Quarter, pp. 45-55
Bangladesh	31.00	37.00	World Bank. 1990. "Bangladesh - Poverty and public expenditures: an evaluation of the impact of selected government programs on the poor." Report 7946-BD. Washington, D.C.: World Bank
Belgium	183.58	642.00	Luttgens, A., S. Perelman and P. Pestieau. 1987. "La pauvreté en Belgique: interprétation d'une enquête." Cahiers économiques de Bruxelles. No. 115, 3rd Trimester, pp. 35-52
Burundi	24.85	27.23	World Bank. 1988. "Report of the poverty task force." Washington, D.C.: World Bank.
Brazil	43.43	235.83	Fox, L. and S. Morley. 1990. "Who paid the bill? Adjustment and poverty in Brazil, 1980-1985." Background paper for World Development Report 1990. Washington, D.C.: World Bank
Canada	290.19	768.50	Gunderson, M. 1983. Economics of Poverty and Income Distribution. Toronto: Butterworths Ltd
China	24.88	51.42	Ahmad, E. and Y. Wang. 1990. "Inequality and poverty in China: institutional change and public policy, 1978-87." Background paper for World Development Report 1990. Washington, D.C.: World Bank
Costa Rica	50.75	191.58	World Bank. 1990. "Costa Rica: Public sector social spending." Report 8519-CR. Washington, D.C.: World Bank
Dominican Republic	48.58	110.83	Musgrove, P. 1986. "Distribucion del ingreso familiar en la Republica Dominicana, 1976-77." El Trimestre Economico. Vol. 53 (2), pp. 341-92
Egypt	25.50	64.67	Radwan, S. and E. Lee. 1986. Agrarian Change in Egypt: An Anatomy of Rural Poverty. London: Croom Helm Ltd
India	23.00	46.92	Dandekar, V. and N. Rath. 1971. Poverty in India. Poona: Indian School of Political Economy. Poverty line updated to 1985 levels using Minhas' method, outlined in B.S. Minhas and others. 1987. "On the choice of appropriate consumer price indices and data sets for estimating the incidence of poverty in India." Indian Economic Review. Vol. 22, no. 1, Jan-June 1987, page 33
Indonesia	31.25	82.50	Rao, V.V.B. 1986. "Indonesia: Poverty trends, 1980-84." World Bank resident mission, Jakarta. Mimeo
Jamaica	71.23	118.08	Gordon, D. 1989. "Identifying the poor: developing a poverty line for Jamaica." Working paper no. 3. Kingston, Jamaica: Planning Institute of Jamaica
Japan	129.91	510.67	Miyoguchi, T. and Takayama, N. 1984. Equity and poverty under rapid economic growth: the Japanese experience. Tokyo: Kinokuniya Company Limited
Kenya	30.63	39.67	Collier, P. and D. Lal. 1980. Poverty and Growth in Kenya, 1900-1980. Oxford: Clarendon Press
Malaysia	58.04	170.50	Bhalla, S. 1989. "Restructuring of the Malaysian Economy: an Evaluation." New Delhi: The Policy Group. Mimeo
Morocco	31.33	89.58	World Bank. 1989. "Morocco: Reaching the Disadvantaged: Social Expenditure Priorities in 1990s." Washington, D.C.: World Bank
Nepal	30.70	42.50	World Bank. 1989. "Nepal: Social Security Strategy Review." Report No. 7698-NEP. Washington, D.C.: World Bank
Pakistan	36.25	58.42	Hassan, S.M. 1973. "Mass poverty in Pakistan: Some preliminary findings." Pakistan Development Review. 12, no. 4 (Winter), pp. 317-360
Philippines	32.25	101.83	World Bank. 1988. "The Philippines: The Challenge of Poverty." Report No. 7144-PH. Washington, D.C.: World Bank
Poland	74.92	175.50	Milanovic, B. 1990. "Poverty in Poland in the years of crisis: 1978-87." Background paper to World Development Report 1990. Washington, D.C.: World Bank
South Africa	88.46	228.83	Wilson, F. and M. Ramphele. 1989. Uprooting Poverty: The South African Challenge. New York: W.W. Norton and Company
Sri Lanka	51.78	135.92	Anand, S. and C. Harris. 1990. "On the importance of the choice of welfare indicators in the estimation of poverty: with an illustration using Sri Lankan data." Background paper no. 25 for World Development Report 1990. Washington, D.C.: World Bank
Taiwan	57.65	195.67	Directorate General of Budget, Accounting and Statistics, Executive Yuan, Republic of China. 1986. "Report on the survey of personal income distribution in Taiwan Area, Republic of China, 1985." Taipei: Directorate General of Budget, Accounting and Statistics
Tanzania	30.96	28.92	Jamal, V. 1981. "Rural-urban gap in Tanzania." ILO Jobs and Skills Programme for Africa working Paper No. 29. Geneva: International Labor Office
Thailand	61.06	134.24	Meesook, O.A. and others. 1989. "The political economy of poverty, equity and growth: Thailand and Ghana." World Bank, Latin America Technical Department. Washington, D.C.: Processed
Tunisia	24.20	154.00	World Bank. 1988. "Report of the Poverty Task Force." Washington, D.C.: World Bank
Turkey	46.22	163.58	Celasun, M. 1986. "Income Distribution and Domestic Terms of Trade in Turkey, 1978-1983." Middle East Technical University (Ankara) Studies in Development. Paper 12 (1,2)
U.K.	163.33	538.17	Atkinson, A.B. 1984. "Poverty in Britain: the 1930s to the 1980s." University of Southampton Discussion Papers in Economics and Econometrics. No. 8409
U.S.	246.67	888.50	Sawhill, I. 1988. "Poverty in the U.S.: Why is it so persistent?" Journal of Economic Literature. no. 26, pp. 1073-1119
W. Germany	251.09	805.17	Hauser, R. and P. Semrau. 1989. "Low income groups and the poor in Germany, 1962-1983: Changes in structure and their relationship to demographic trends and changes in the social security system." Paper presented at the 21st General Conference of the International Association for Research in Income and Wealth, Bahnstein, W. Germany, August 20-26, 1989. Poverty line for single person in 1983 based on a series of set allowances, plus the cost of housing and heating, which is not given. In calculating the poverty line, housing and heating were assumed to account for 30 percent of total income
Venezuela	53.48	273.08	Garcia, E. and J.L. Newman. 1981. "Poverty in Venezuela." Asociacion Venezolana para el Desarrollo de la Investigacion en Salud/Welfare and Human Resources Division, World Bank. Mimeo
Zambia	18.33	36.50	World Bank. 1988. "Report of the Poverty Task Force." Washington, D.C.: World Bank

Note: The poverty lines chosen are the lowest available (most often for rural areas), and on a per capita basis for the average household size. Consumer price indices from the International Financial Statistics are used to inflate or deflate to 1985 levels unless otherwise noted.

Appendix 2: Model for Predicting PPP Exchange Rates

Right hand side variable	Coefficient	Standard error	
Intercept	-2.001	1.766	
Official exchange rate (log)	.980	.014	
Mean private consumption at official exchange rate (log)	1.118	.379	
Squared value of above	-.599	.273	(x10)
Infant Mortality Rate	-.559	.359	(x100,
Life expectancy	-.555	.160	(x10)
Urbanization (log)	.133	.078	
CHINA (=1, 0 otherwise)	1.481	.329	
BURMA (=1, 0 otherwise)	1.292	.310	

R-Squared = .986
F-statistic F(8,77) = 662
S.E.E.= .290
Mean of dependent variable = 2.218
St.dev. dependent variable = 2.310
Ramsey RESET test of functional form F(1,76)=.71
LM test for normality CHI-SQ(2)= 1.44
LM test for heteroscedasticity CHI-SQ(1)=.37

Estimated PPP rates to $US:
China: 0.67 (23% of official rate)
Burma: 2.33 (27% of official rate)

Note: The dependent variable is the log of the constant PPP exchange rate for 1985 from Summers and Heston (1988). For China and Burma, this is set at the official rate when estimating the regression.

Appendix 3: Summary of Distributional Data

	(1) Year	(2) Y/E	(3) HH/PC	(4) Rank By	(5) F/L	(6) PPP	(7) Estimation method z=$31	(8) z=$23
Indonesia	84	E	PC	PC/E	F	352.17	K	K
Malaysia	84	Y	PC	PC/Y	F	1.26	Q	Q
Philippines	85	E	HH	HH/E	F	6.88	K	K
Thailand	86	E	HH	PC/E	F	7.96	Q	Q
China	85	E	PC	PC/Y	F	0.67	Q	Q
Bangladesh	81/82	E	PC	PC/E	F	8.40	K	K
India	83	E	PC	PC/E	F	4.05	K	K
Pakistan	84/85	E	HH	HH/E	F	5.90	K	K
Sri Lanka	85/6	Y	PC	PC/Y	F	4.97	K	K
Brazil	85	Y	PC	PC/Y	F	2.53	Q	Q
Colombia	88	Y	HH	PC/Y	L	51.27	K	K
Costa Rica	82	Y	HH	PC/Y	L	72.30	K	K
Guatemala	79-81	Y	HH	HH/Y	L	0.76	K	K
Jamaica	88	E	PC	PC/E	L	2.37	K	K
Peru	85	E	PC	PC/E	F	3.62	K	K
Venezuela	87	Y	PC	PC/Y	F	5.14	K	K
Botswana	85/86	Y	PC	PC/Y	L	0.64	E	E
Cote d'Ivoire	85	E	PC	PC/E	F	250.06	K	K
Ghana	87	E	PC	PC/E	F	64.49	K	K
Morocco	84/5	E	HH	HH/E	F	3.51	L	L
Poland	85	Y	PC	PC/Y	F	81.87	L	L
Yugoslavia	85	Y	PC	PC/Y	F	135.80	K	K

Notes:

(1) Year of the survey.
(2) "Y" indicates income, "E" indicates expenditure.
(3) "HH" indicates household distribution, "PC" indicates per capita distribution
(4) This column indicates how observation units were ranked in each distribution. e.g.,"PC/E" represents ranking by per capita expenditure, and "HH/Y" represents ranking by household income.
(5) F" indicates data are in the form of a frequency distribution of households/persons, L" indicates data are in the form of income shares.
(6) PPP exchange rates from Summers and Heston (1988) except as noted in text.
(7),(8) Method used for estimating poverty measures.
"K" is for Kakwani Lorenz parameterization.
"Q" is for Quadractic interpolation.
"E" is for Eliptical Lorenz estimation.
"L" is for Linear interpolation.

Notes

1. This is analogous to the concept of the "subjective poverty line" based on household surveys of income norms (for discussion and references see Kapteyn et al., 1988).

2. Standard errors are given in parentheses below each coefficient. NORM, HETERO, and RESET are the Lagrange multiplier tests for normality, heteroscedasticity, and functional form respectively, distributed as Chi-square, with degrees of freedom in parentheses.

3. See, for example, Kravis et al., (1978), Berry et al., (1983, 1989), Grosh and Nafziger (1986), Yotopoulos (1989).

4. In general, we can write the FGT class of poverty measures for any distribution of income or consumption $\{y_i\}$, i=1,..,n, as follows:

$$P_\alpha = \sum_{y_i<z} [(z-y_i)/z]^\alpha/n$$

where α is a non-negative parameter. H is then obtained when $\alpha = 0$, while PG is obtained when $\alpha = 1$.

5. Villasenor and Arnold (1989) compare various Lorenz specifications, including the Kakwani-Podder model, on Australian data and find the elliptical model to be preferable. However, their comparison does not include the Kakwani specification used here.

6. Though the Kakwani specification can go astray at very low values of p due to the limiting properties of its slope. This does not appear to be a practical problem here.

7. A valid Lorenz curve L(p) must be monotonic increasing and strictly convex for p in the (0,1) interval. When not implied for all such p, this was tested in the neighborhood of the estimated headcount index. A valid Lorenz curve should also have the limiting properties that L(0)=0 and L(1)=1. However, we have not imposed or tested these conditions (and they do not hold for the Kakwani model), on the grounds that we are mainly interested in obtaining a good interior fit.

8. The following decision rule was followed rigorously: If the Kakwani specification failed (by violating the theoretical conditions for a Lorenz curve), then the elliptical model was used. If this failed then quadratic interpolation was used. If this failed (by yielding negative densities in the relevant region) then linear interpolation was used.

9. For two countries - Bangladesh and Pakistan - the predicted PPP from the model in Appendix 1 was used in preference to the Summers and Heston figure, which was somewhat lower and gave estimates of the mean consumptions for those countries which were higher than we considered plausible. The need for this

adjustment was confirmed in discussions with Bank economists who work on those countries.

10. This is the 1985 population weighted mean of the consumption per capita estimates at constant PPP implied by Summers and Heston (1988, Table 3), after correcting the typing errors for India and El Salvador.

11. This is based on the elliptical model. The Kakwani specification violated the theoretical conditions for a Lorenz curve.

12. Note that this is an "arc elasticity", which will generally differ from the point elasticities at both poverty lines. The point elasticity for the headcount index requires estimation of the density function of incomes at the poverty line. That is only possible for the sub-set of countries for which we have distributional data.

13. The correlation coefficients between predicted and actual Lorenz curves for 1986 over the 11 available points on the interior of the (0,1) interval are .9998 based on the 1960 Lorenz curve and .9999 based on 1970. The standard deviations of the errors in prediction are .0061 and .0078.

14. This uses a result due to Blackburn (1989).

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Figure 1

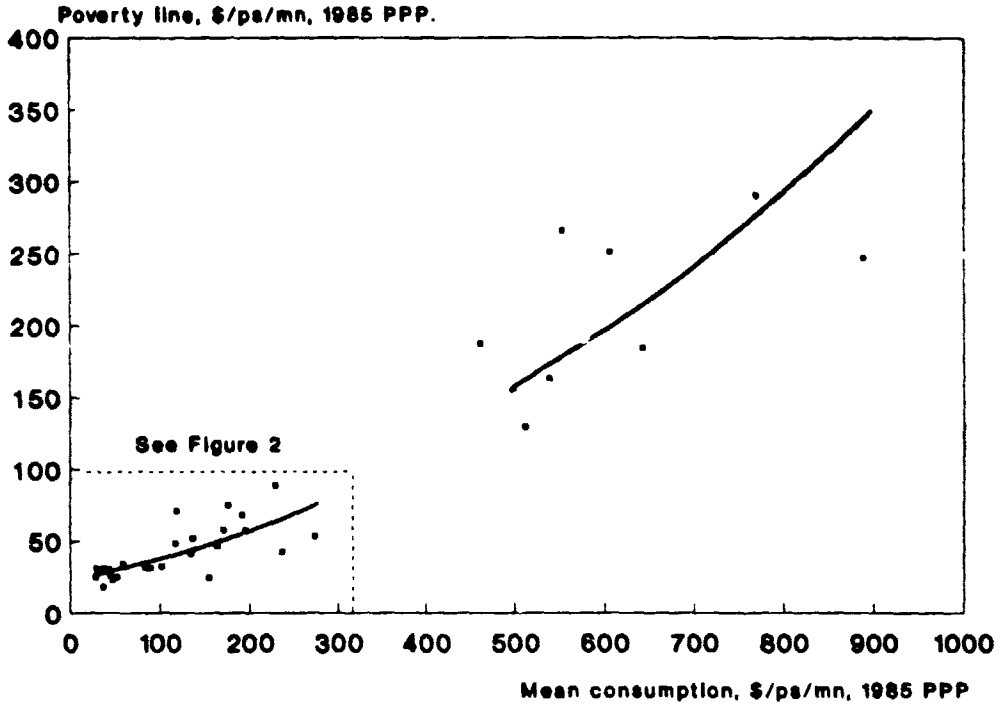


Figure 2

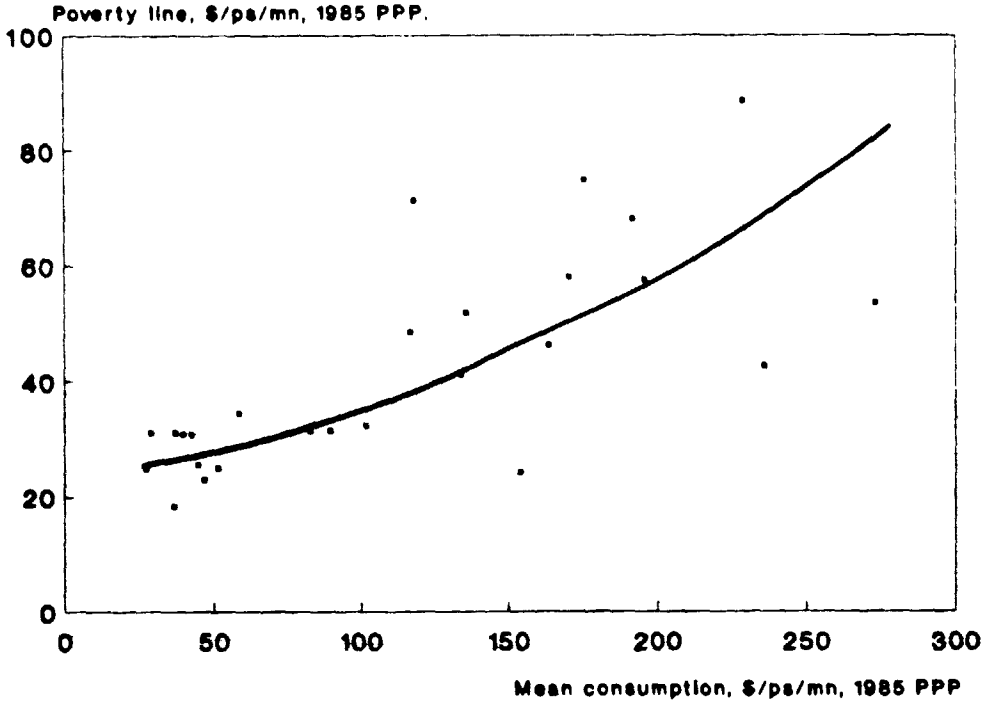


Figure 3

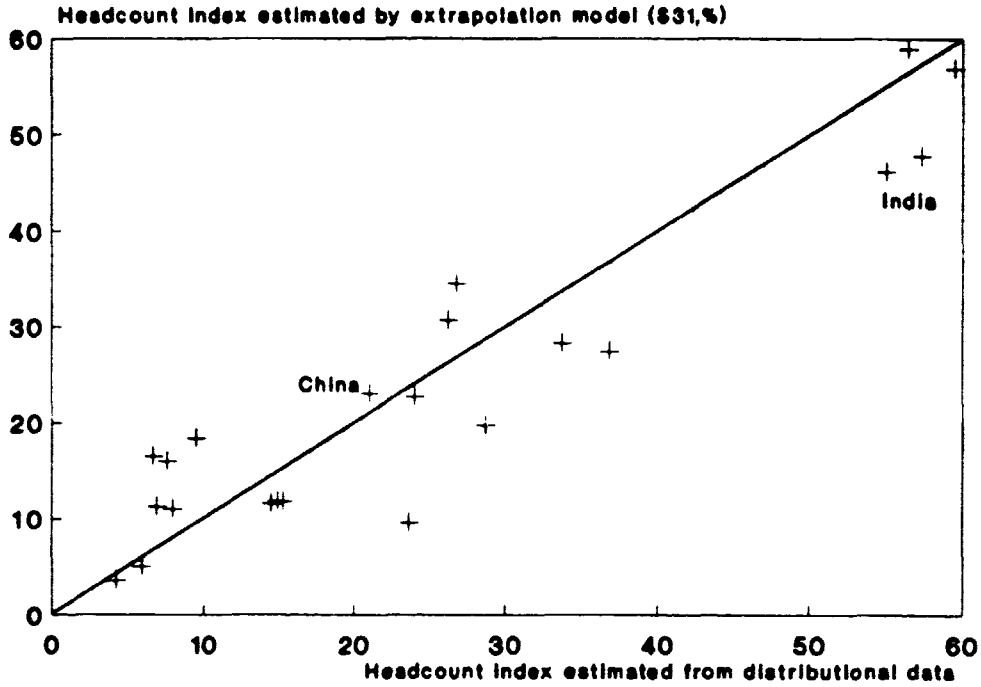


Figure 4

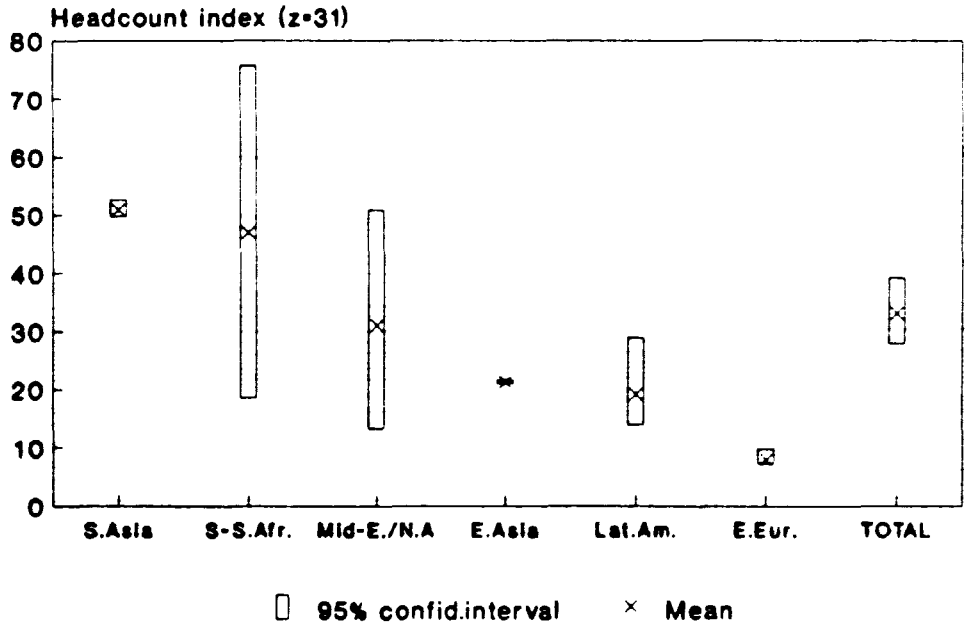
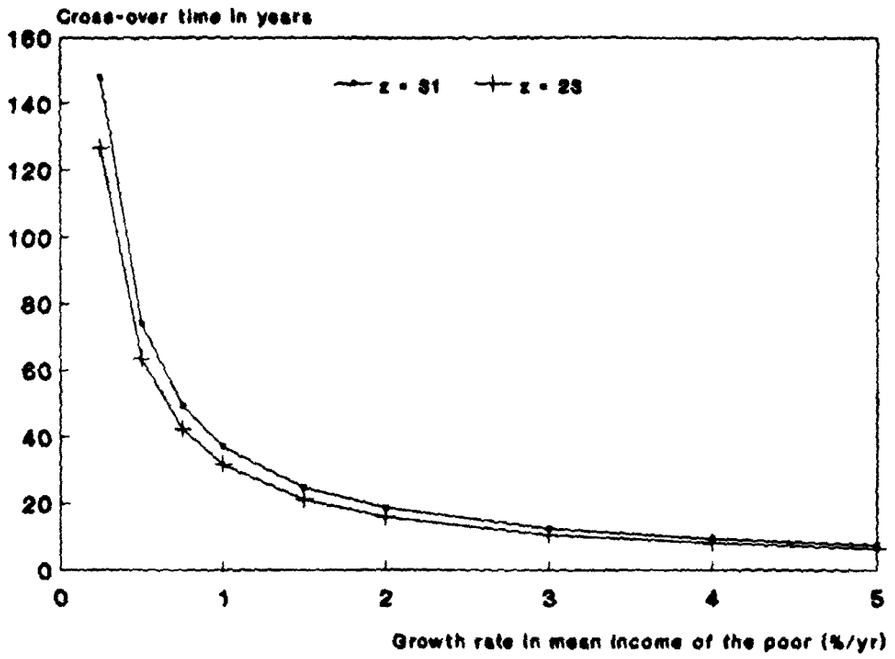


Figure 5


Cross-over time in years
160
140
120
100
80
60
40
20
0
z = 31
z = 23
0
1
2
3
4
5
Growth rate in mean income of the poor (%/yr)

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